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An Emission Inventory and Assessment of Demonstrated Control Technology: Air Pollution Sources in Grant County, New Mexico

Engineering-Science, Inc.
Arcadia, CA

Prepared for

Environmental Protection Agency
Dallas, TX

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Report presents results of particulate and sulfur dioxide emission inventories for Grant County, New Mexico. The report also assesses possible control measures of these emission sources.

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U.S. ENVIRONMENTAL PROTECTION AGENCY
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AN EMISSION INVENTORY AND ASSESSMENT OF DEMONSTRATED TECHNOLOGY

Air Pollution Sources in
Grant County, New Mexico

May 1979

Prepared by

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for the

U.S. Environmental Protection Agency
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Contract #68-02-2537
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DISCLAIMER

This report has been reviewed by Randall E. Brown, EPA, Region VI, and approved for publication. Approval does not signify that the contents necessarily reflect the views and policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

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SECTION I
INTRODUCTION

The U.S. Environmental Protection Agency Region VI contracted to Engineering-Science to update the emission inventory for total suspended particulates (TSP) and sulfur dioxide (SO_2) in the area of Hurley, New Mexico, Grant County, and the small towns and mining areas to the north of Hurley; and to assess available controls (Reasonably Available Control Technology [RACT]) that could be applied to the local air pollution sources. The major industry in Grant County is the Chino Mines Division of Kennecott Copper Corporation, which has a concentrator and pyrometallurgical smelter located just east of the town of Hurley, and which has associated activities in the areas to the south, west, and north of Hurley. This work was performed to assist New Mexico in developing information to be used in the State Implementation Plan revisions required under the 1977 Clean Air Act Amendments.

Engineering-Science visited Grant County and the smelter on three occasions, both to develop emission inventory information and to evaluate the ability of the air quality monitoring network to produce representative air pollutant data. ES met with EPA and the New Mexico Environmental Improvement Division in July, August, and September to submit interim reports and to discuss results of the study. Following the August meeting, EPA authorized that the study be expanded to include a dispersion model for the area, from which could be developed the cost effectiveness of various control strategies for ambient pollutant concentration reductions.

Drafts of this report were submitted to EPA in September and October and some modifications were made to incorporate EPA's comments. In October, Engineering-Science was asked to review the proposed New Mexico regulations that affect the Hurley area and to calculate emission rates and the effect on ambient air quality of the implementation of these regulations.

Section II of this report contains the emission inventory and explanation of methodology; Section III is an assessment of control methods which could be applied to the sources and the costs involved; and Section IV

shows the results of dispersion modeling, the estimated cost per unit of pollutant emission reduced from each source, the estimated cost per unit of ambient air concentration reduction from each source, and the ambient air quality that can be achieved through implementation of various emission reduction efforts. Section V was added to reflect the impact of proposed New Mexico regulations on emission rates and air quality. This section contains a revised emission inventory and the expected impact on air quality from modeling the reduced emission rates.

SECTION II

EMISSION INVENTORY

Table II-1 lists the air pollution sources in the Hurley, New Mexico study area, along with the current emission control methods, the estimated emissions from each source and an indication of the estimate methodology. Figure II-1 is a map of Grant County showing the general location of air pollution sources in the study area, and Figure II-2 is a map of Kennecott's Hurley smelter showing the air pollution sources within the smelter. In preparing the emission estimates, direct source test information was used where available and EPA publication AP-42 was also used. For some of the sources, such as the lime crusher, available AP-42 emission factors estimated emissions far in excess of those that seemed reasonable from visual observation of the sources. In these cases, and in cases where no emission factor was available, judgement estimates were made by comparing the visual emissions from these sources with the visual emissions of sources having emission test information. The effect of particle size on visibility was considered in these visual judgements.

EPA staff commented on several of the estimates made in the October draft of this report, both in judgement and in calculation methods. This current report reflects these comments.

KENNECOTT COPPER CORPORATION SOURCES

Reverberatory Furnace - Sulfur Dioxide

Ecology Audits' source test[1] (attached) of March, 1978 showed SO_2 emissions at 23,670 lbs./hr. or 284 tons/day. Mr. Madden of Kennecott stated, during the June visit by ES and New Mexico Environmental Improvement Agency staff, that at the time of the test the plant was processing unusually high sulfur feed and that emissions normally are significantly less. Kennecott's August 8, 1978 written response[2] to questions submitted by ES[3] (both letters attached) shows an average sulfur dioxide emission rate of 10,200 lbs./hr., or 122 tons/day. For this emission inventory and impact assessment, the higher number of 284 tons/day was used.

TABLE II-1

EMISSIONS INVENTORY, HURLEY, NEW MEXICO STUDY AREA

Source		Current Controls	Estimated Emissions lbs./day	Emission Estimate Methodology
Reverberatory Furnace	SO_2	None	568,000	Ecology Audits' 1978 source test
	Part.	ESP	23,700	Ecology Audits' 1978 source test with adjustment for 1977
Converter Aisle, Transfer Points, etc.	SO_2	Limited Hooding	306,000	Sulfur Balance
	Part.	Limited Hooding	3,740	Visual Observation
Lime Kiln	Part.	Cyclone	5,280	Kennecott source test
Lime Crushing	Part.	Water Spray	520	Visual Observation - comparison
Acid Plant	SO_2		2,540	Ecology Audits' 1978 source test
	Part.		520	Ecology Audits' 1978 source test
Reverberatory Feed Storage	Part.	Limited water spray	2,480	AP-42 Emission Factors
Reverberatory Dryer	Part.	Scrubber	460	Ecology Audits' 1978 source test
Fire Ref. Furnace	Part.	Comb. Mod.	2,000	Ecology Audits' source test - adjusted (see text)
Power Boilers	SO_2	None	10,000	N. M. Environmental Imp. Testimony B. Nicholson
	Part.	None	1,520	N. M. Environmental Imp. Testimony B. Nicholson

TABLE II-1 (CONT'D.)

EMISSIONS INVENTORY, HURLEY, NEW MEXICO STUDY AREA

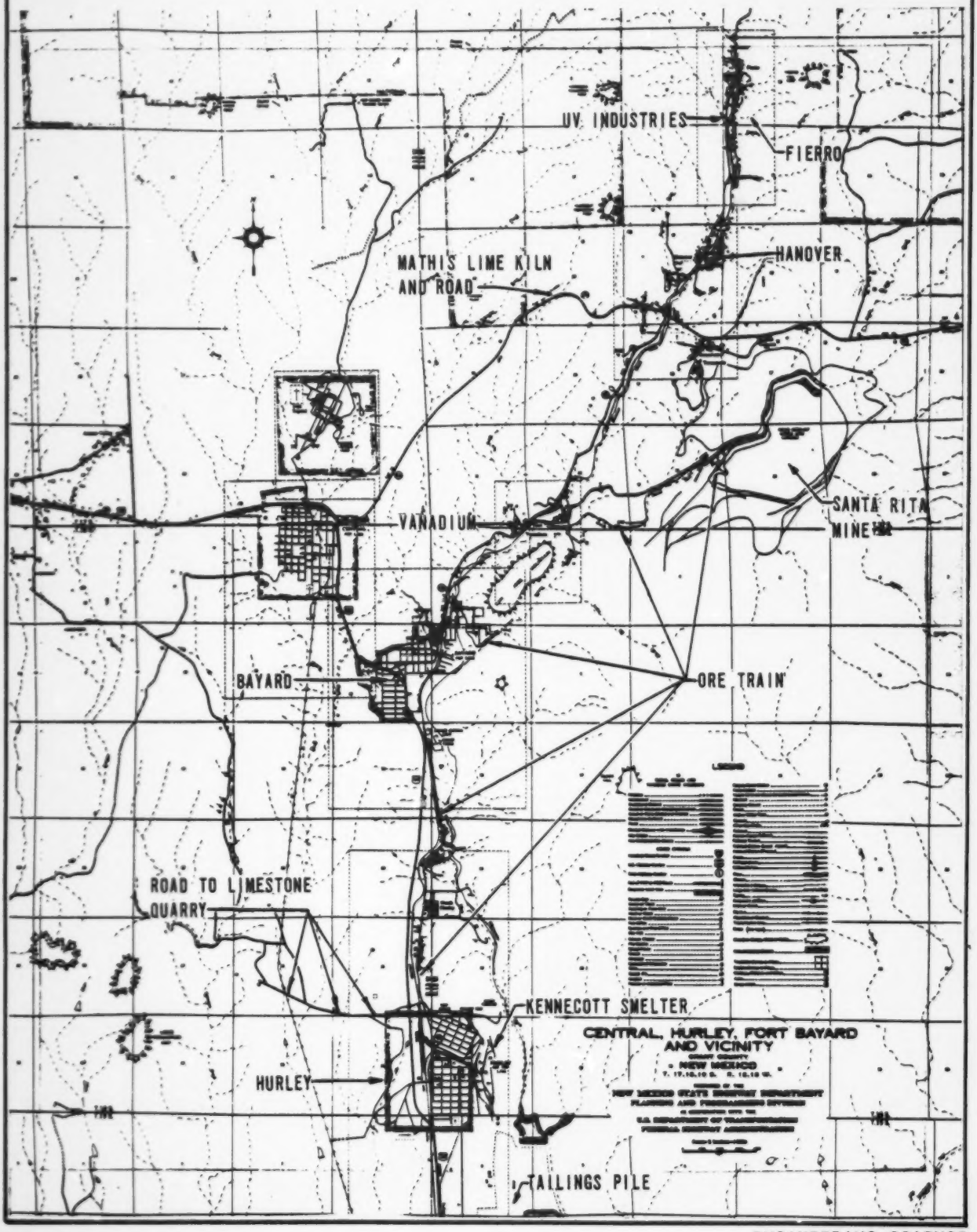
Source	Current Controls	Estimated Emissions lbs./day	Emission Estimate Methodology
Copper Ore Crusher	Part. Cyclone	1,200	Source tests - 1975
Silica Rock Crusher	Part. B.H.	40	Estimate
ESP Dust Load	Part. Partial enclosure	500	Visual Observation comparison
In-Plant Traffic	Part. Dust Suppression	3,720	AP-42 Emission Factors
Tailings Pile	Part. Vegetation (limited)	2,000	Pedco-Butte Anaconda Study
Santa Rita Mine	Part. Dust Supp.	4,000	Pedco-Butte Anaconda Study
Road to Limestone Quarry	Part.	1,440	AP-42 Emission Factors
Ore Train	Part.	720	AP-42 Emission Factors
Hurley	Part.	3,800	AP-42 Emission Factors
Bayard	Part.	4,200	AP-42 Emission Factors
U. V. Industries	Part.	1,800	Comparison
Mathis Lime Kiln & Road	Part	4,340	Comparison

TABLE II-1 (CONT'D.)

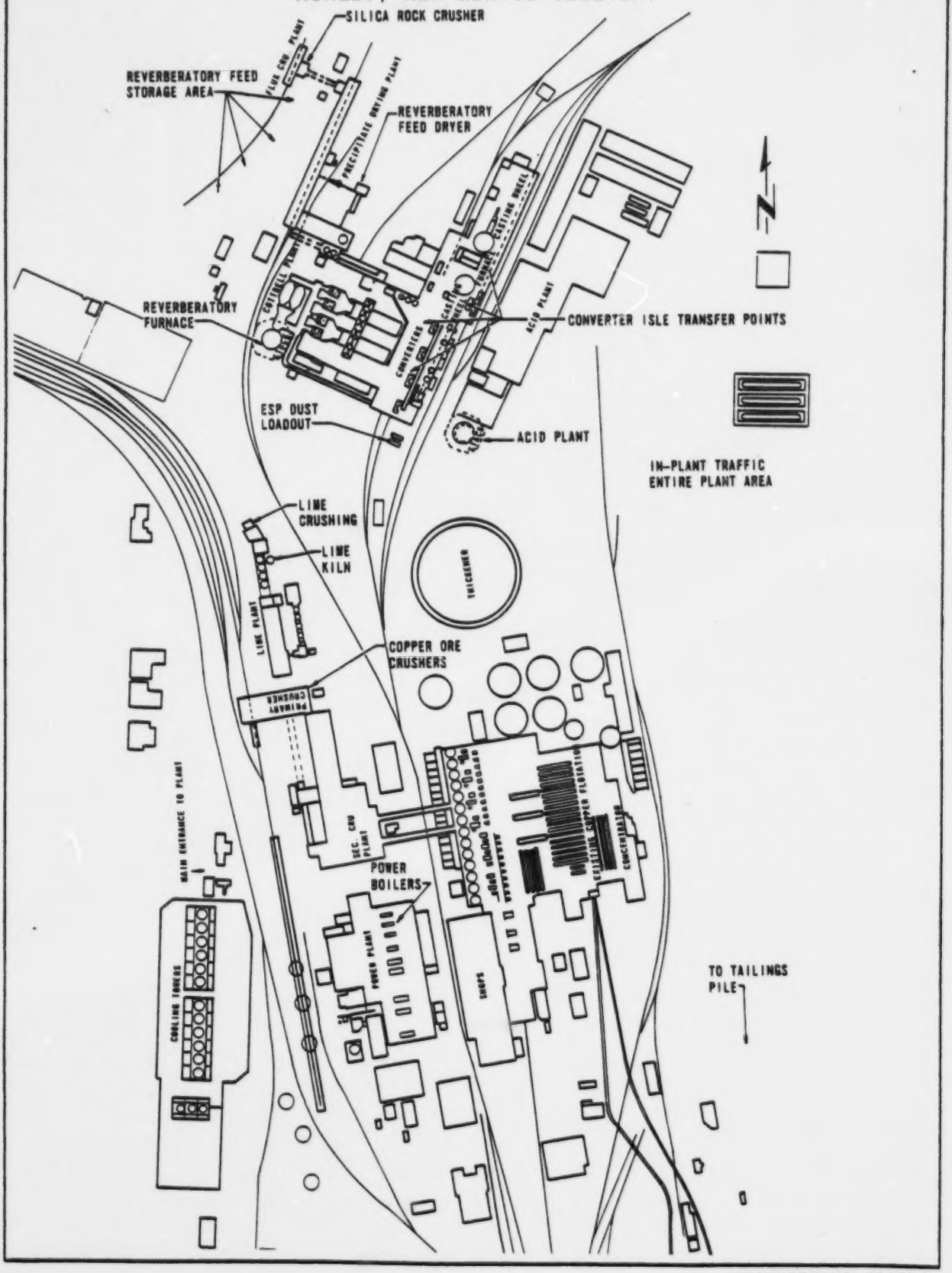
EMISSIONS INVENTORY, HURLEY, NEW MEXICO STUDY AREA

Source	Current Controls	Estimated Emissions lbs./day	Emission Estimate Methodology
Fierro	Part.	140	AP-42 Emission Factors
Hanover	Part.	140	AP-42 Emission Factors
Vanadium	Part.	140	AP-42 Emission Factors

PLOT PLAN - EMISSION SOURCES IN HURLEY STUDY AREA



PLOT PLAN OF EMISSION SOURCES, KENNECOTT COPPER CORPORATION, HURLEY, NEW MEXICO SMELTER



Reverberatory Furnace - Particulate

The Ecology Audits[1] source test of March, 1978 measured average particulate emissions of .484 gr./dscf, or 450 lbs./hr., 5.4 tons/day. The test was conducted with the No. 1 reverberatory furnace on line and the No. 2 reverberatory out of service. With the No. 1 furnace on line, all of the gases, according to Mr. Madden of Kennecott, pass through the electrostatic precipitator (ESP) before discharge to the stack. When No. 2 furnace is on line and the No. 1 furnace is out of service, due to the physical arrangement of the furnace and ducting, only about 40 percent of the gases vent to the ESP and the remainder vent via a by-pass directly to the stack. The switch from No. 2 furnace to No. 1 furnace, according to Mr. Madden, came in mid-1977. To estimate the uncontrolled emission rate from the measured emission rate requires an estimate of the ESP collection efficiency. A study performed for EPA by Pedco Environmental, "Evaluation of Particulate Matter Control Equipment for Copper Smelters[4], and summarized in a paper by Larry Bowerman of EPA[5], found over 50 percent of the particulate in the two smelters tested to be in a volatile form as it passes through the ESP, and therefore not collectable. Much of the volatile material from the smelters tested, however, was found to be arsenic trioxide, a compound which, according to New Mexico Air Quality Staff, is not a major constituent of the Chino Mines. The low arsenic content of the Chino Mines is also reported in a study done for EPA by Pacific Environmental Services[6] at the Hurley smelter in 1975. Considering the relatively low volatile content of the Chino Mines ore, the ESP collection efficiency is subjectively estimated at 80 percent.

At 80 percent collection efficiency, the uncontrolled ESP emission is

$$\frac{5.4 \text{ T/D}}{100\%-80\%} = 27 \text{ T/D}$$

No. 1 Furnace emission rate for 1977 =

$$= 5.4 \text{ T/D } (182 \text{ D}) = 983 \text{ Tons}$$

No. 2 Furnace emission rate for 1977 =

$$= \left[27 \ (100\%-80\%) \ (40\%) + 27 \ (60\%)\right] \ 182 = 3341 \text{ Tons}$$

Average 1977 daily emission = $\frac{983 + 3341}{365} = 11.85$ T/D

Converter Aisle, Transfer Points, Ect. - Sulfur Dioxide

Sulfur balances maintained by Kennecott and observed on a computer printout during the June 6, 1978 visit to the plant indicated sulfur fugitive emissions are approximately 13 percent of the sulfur feed to the plant, and with the acid plant in operation are approximately 50 to 55 percent of the reverberatory stack emissions. The sulfur balance shown in the August 8, 1978 letter from Kennecott[2] also showed this approximate ratio. The August 8 letter, however, listed reverberatory stack emissions at less than half of those measured by Ecology Audits in March of 1978. For this estimate, the same ratio of stack emission to fugitive emission was applied to estimate the fugitive emissions, as follows:

Calculations

$$\frac{\text{33 TPD S Fug. (Kennecott letter)}}{\text{61 TPD S Stack (Kennecott letter)}} = \frac{\text{Estimated Fugitive } SO_2 \text{ Emissions}}{\text{284 TPD Measured } SO_2 \text{ Emissions}}$$

Estimated Fugitive SO_2 Emissions - 153 T/D

Note: Dispersion modeling, using the 153 tons/day fugitive emission number, show ambient concentrations over 100 times those measured by the ambient monitoring network. The inaccuracy of the AQDM model could account for a factor of 10 in this number, still leaving the calculated concentrations at 10 times higher than that indicated from the measured ambient data. Even using Kennecott's lower sulfur smelter throughput leaves the calculated concentrations at 5 times those measured. The differences in the calculated and measured data indicate the fugitive sulfur dioxide emission levels may be less than the above estimate and the sulfur balance was in error, or the ambient monitoring network was not functioning properly.

Converter Aisle, Transfer Points, Ect. - Particulate

Several approaches were attempted in estimating these emissions. The ratio of measured stack emissions to fugitive emissions for SO_2 obtained through the sulfur balance could not safely be applied to particulate because the stack particulate emissions are partially controlled with an ESP, and the SO_2 emissions from this source are uncontrolled. If this method were applied it would be necessary to calculate an uncontrolled stack emission from the measured data, estimating an ESP collection efficiency.

Assuming an 80 percent collection efficiency, uncontrolled particulate calculates from the measured data to be 27 tons/day. Applying the stack sulfur oxide to fugitive sulfur oxide ratio results in 27 $(\frac{153}{284})$ = 14.6 tons/day, which is more than the measured stack particulate emission. Visual comparison indicates this is simply not the case. Information from tests at ASARCO's El Paso smelter on fugitive emissions and applied to the Hurley smelter also result in estimated emissions in excess of those measured from the Kennecott reverberatory stack. Again, visual comparison of the two sources shows this is not so. It was therefore decided to make the fugitive estimate on a visual comparison to the stack emission, which appeared to be a maximum of approximately 35 percent.

.35 x controlled reverberatory stack emission of 5.4 T/D = 1.89 T/D

Lime Kiln - Particulate

Source tests conducted by Kennecott Copper Corporation staff members on the lime kiln on June 9, 1978[7] showed an average 220 lbs./hr. emission rate, or 2.64 tons/day.

Lime Crushing - Particulate

Kennecott's August 8, 1978[2,3] letter in response to Engineering-Science's questions indicated the crusher operated seven hours per day at 35 tons per hour, processing 245 tons of lime rock per day. The letter also indicated that six truckloads per day were delivered, which would average approximately 40 tons/load. Dust is controlled during the unloading and crushing with the use of water sprays. Applying the AP-42 emission factor to these sources required an arbitrary judgement of the water spray system's effectiveness. The uncontrolled emissions using AP-42 (Section 8.15.1) shows an emission rate of 3.5 tons/day (it is assumed that truck dumping is included in this factor). Assuming water sprays would control these emissions by 70 percent, the emission rate calculated to 2.45 tons/day, in the same range as the measured lime kiln emission. Because from visual observation it appeared that truck dumping and crushing operations emitted much less than the lime kiln, it was decided to make a subjective comparison of the two sources to estimate the emission rate. It was therefore visually estimated that the combined dumping and crushing emissions when operating were one-third of the

lime kiln emissions. For the seven hour per day operation, the emissions were estimated as follows:

$$1/3\ (2.64)\ (\frac{7}{24}) = .26\ T/D$$

Acid Plant Stack - Sulfur Dioxide

Ecology Audits' 1978 source test[1] (appended) found SO_2 emissions at 106 lbs./hr., not including SO_3. This calculates to 1.27 tons/day.

Acid Plant Stack - Particulate

Ecology Audits' 1978 source test[1] found .25 tons/day of particulate, of which just under one-half was SO_3.

Reverberatory Feed Storage - Particulate

Concentrate from the concentrator dumps onto a storage pile from a conveyor. A front end loader carries the concentrate to a hopper for conveying to the reverberatory feed dryer. Dust was observed becoming airborne both from the material handling activity, traffic through the area, and the wind. At the time of the recent visit the pile and spillage area was an estimated 100 by 200 feet and approximately 25 feet high. Section 11.2.3-1 of AP-42 pertaining to aggregate storage piles was applied to estimate emissions from this source. From the PE index map it appears that Hurley may be on the border area between 19 and 34, averaging 26.

$$E = \frac{.33}{\left(\frac{26}{100}\right)^2} = 4.88\ \text{lbs./ton placed in storage}$$

Adjustments to the factor from Table 11.2.3-1 in AP-42 and from observations of the source are as follows:

Source Activity	Approx. Percentage Contribution AP-42	Absolute Value (4.88 #/T x Approx. Percentage)	Adjusted Absolute Value (From Observations)	Adjusted Percentage Contribution
Loading onto piles	12	.59 #/T	Reduced By 75% = .15 #/T	7
Vehicular Traffic	40	1.95 #/T	Reduced By 75% = .49 #/T	24
Wind Erosion	33	1.61 #/T	Reduced By 40% = .97 #/T	46
Loadout from piles	15	.73 #/T	Reduced By 33% = .48 #/T	23
	100%	4.88 #/T	2.10 #/T	100%

From material balance obtained during the June 1978 visit to Kennecott, the concentrate processed is 884 tons/day. The Kennecott letter indicated the average was 605 tons/day (question no. 3). Using the higher number, estimated emissions are as follows:

884 T/D x 2.1 lbs./T = .93 T/D

Reverberatory Dryer - Particulate

Ecology Audits' source test[1] showed 19 lbs./hr., or .23 tons/day.

Refinery Furnace - Particulate

Ecology Audits[1] tested the refinery furnace during "charging", blowing, and while "poling" the furnace. Emission rates were respectively 16 lbs./hr., 26 lbs./hr., and 98 lbs./hr. However, the Ecology Audits report gave no breakdown on the operational sequence. A study commissioned by Kennecott and conducted by Intera Environmental Consultants[8] estimated the daily hours of the various operations as three hours "polling", two hours "fluxing", six hours unspecified and the furnace idle for 13 hours. These emission rates were taken from a source test conducted by Ecology Audits for Kennecott in 1975.[7] Average emission rates using the Intera operating hours and Intera emission estimates average just less than 1 ton/day. Using Ecology Audit for 11 hrs./day totals approximately .75 tons/day. For this emission inventory the 1 ton/day estimate was used.

Power Boilers - Particulate

Bruce Nicholson of the New Mexico Environmental Improvement Division, using 1977 hours of operation, calculated average emission rates[10] for the three boilers for the year 1977. Total boiler hours for the entire year were 2,679. Averaged over a 365 day period, emissions average .18 tons/day.

Power Boilers - Sulfur Oxides

Information from Bruce Nicholson's report compiled from the same operating date as particulate shows average daily sulfur oxide emission rates of 1.2 tons/day.

Copper Ore Crusher - Particulate

The Intera report lists emissions at 100 lbs./hr. Mr. Madden, in a telephone conversation, indicated these were measured results from the

Ecology Audits' 1975 source test. At approximately one-half time operation, the average emissions rate calculates to .6 tons/day.

Silica Rock Crusher

The silica crusher is equipped with a baghouse. It is estimated that emissions are therefore much less than the limestone crusher. This unit operates only two hours per day. Estimated subjective emissions are .02 tons/day.

ESP Dust Loadout - Particulate

This source consists of the dumping of ESP dust from a conveyor onto a truck. The area was only partially protected from the wind, and dust was observed becoming windborne. Only a subjective estimate could be made of these emissions. They were estimated to be two times that of the kiln emissions. Mr. Madden estimated this unloading occurred for eight hours per week.

$$E = \frac{8 \text{ hrs./wk. } (220 \text{ lbs./hr.}) \ 2}{7 \text{ days/wk. } 2000 \text{ lbs./t}} = .25 \text{ T/D}$$

In-Plant Traffic (Including Travel to Tailings Pile) - Particulate

Mr. Madden of Kennecott estimated total vehicle miles per day to 1400. There is some paving, gravel, and dust suppression applied in the plant and adjacent areas, but on much of the paved areas there is evidence of dust that has been tracked to the pavement by vehicles or carried by wind. The overall silt content was estimated at 10 percent, just less than that of gravel. The speed in the plant varies but is estimated to average less than 20 mph in the plant interior and over 30 mph on the road to the tailings pile and around the plant boundaries. The average speed was therefore assumed to be 25 mph. A portion of the vehicles have six tires, so an adjustment factor of 1.25 was included. The 0.6 in the second equation adjusts to include only the <30 μm portion of the emission, i.e., that portion remaining suspended (AP-42, pp. 11.2-2).

$$10 \ \frac{25}{30} \left(\frac{365-60}{365}\right) = 7.\#/\text{VM}$$

$$E = 7 \ (1400) \ \frac{1}{2000} \ (1.6) = 2.94$$

Tailings Pile - Particulate

Pedco Environmental, in a study for the Butte-Anaconda Air Quality Maintenance Area,[11] developed an emission factor of .27 tons per acre per year for emissions from tailings piles. From visual observation the evidence of windblown tailings at Hurley are less than those at Anaconda, and the calculated 1.3 tons/day for the 1800 acre Kennecott tailings pile was reduced to 1 ton/day.

Santa Rita Mine - Particulate

The Pedco report for the Butte-Anaconda area estimated the open pit mine emissions at 16 tons/day. The Chino mine reduction rate is approximately one-half that of the Anaconda smelter, which would indicate an average daily emission of 8 tons/day. Visual observation of the Santa Rita mine indicated little emission and the estimate was therefore lowered to 2 tons/day.

Road to Limestone Quarry - Particulate

Kennecott indicated in the August 8 letter that six loads per day of lime rock are delivered to the crusher from the quarry, for a total estimated 36 vehicle miles. Tire surface area of each truck is at least ten times that of a passenger car. A 12 percent silt content was assumed for the gravelled road. Average speed was assumed to be 25 mph.

$$E = .81\ (12)\ \frac{25}{30} \qquad \frac{365-60}{365}\ (10) = 65\ \text{lbs./VM}$$

$$E = 65\ \text{lbs./VM}\ (36)\ \frac{1}{2000}\ (.6) = .72\ \text{T/D (suspended portion)}$$

Ore Train - Dust Picked Up by Train Movement - Particulate

Dust was observed from the train Right-of Way. No factors are available and for calculating purposes, the train was considered a long car.

Non-Kennecott Sources

Estimates of particulate emissions were calculated from AP-42 emission factors for unpaved roads and re-entrained dust. Average daily traffic (ADT) was obtained from county road departments, and for streets not under jurisdiction of the county road department, ADT were estimated from a count of the houses on each street.

It was assumed that 4 trips were made to each house daily, over one-half the length of the street. The emission factors for unpaved streets was calculated as follows:

Assume: 25 percent silt content
20 mph average speed
60 percent remains suspended

$$E = .81\ (25)\ \frac{20}{30}\ \frac{365-60}{365}\ (.6) = 6.77\ \#/VM$$

SECTION III

DEMONSTRATED CONTROL TECHNOLOGY, EMISSION REDUCTION, AND COST OF CONTROL

Table III-1 lists the sources, control technology, and costs on an annualized basis of controlling the Hurley study area sources. The table also lists the emission reductions attainable with demonstrated technology, and the cost per daily pound of emission reduction. Contol methodology and cost estimates for control of the pyrometallurgical smelter were obtained through review of several documents, most of which were the result of EPA contracted studies for non-ferrous smelter control. Control technologies and cost estimates for other sources were developed from literature review and the experience of Engineering-Science. The following paragraphs list the sources and the methodology used in assessing demonstrated control technology, cost of control, and expected emission reductions.

KENNECOTT RELATED SOURCES

Reverberatory Furnace - SO_2

Sulfur oxide emission reduction from reverberatory furnaces has been investigated intensively since the mid-1960s and is still continuing. Reverberatory offgases normally contain sulfur oxide streams too low in concentration to be suitable for acid plant feed. In some smelters the reverberatory furnace has been replaced by other types of smelting systems (Noranda process*, electric furnace, etc.) that produce rich SO_2 streams. In still other systems, efforts have been directed toward concentrating the streams with DEA scrubbers, or blending the weak streams with very strong streams from a roaster or converter. The addition of a roaster alone will achieve substantial reductions by driving off much of the sulfur oxide otherwise released from the reverberatory furnace. The roaster produces a stream rich enough for acid conversion. From reviewing the literature and from discussion with staff of EPA's Industrial Process Research group, it appears that substantial SO_2 reductions (50-90%) cannot be achieved without major smelter modifications, with minimum estimated capital costs of $25,000,000 and annualized costs of $5,000,000.

TABLE III-1

DEMONSTRATED CONTROL TECHNOLOGY, EMISSION REDUCTION, AND COST

SOURCE	DEMONSTRATED CONTROL TECHNOLOGY		ANNUALIZED COST $/YR	AMOUNT REDUCED #/D	COST EFFECTIVENESS $/#
Reverberatory Furnace	SO_2	Gas blending & acid plant, roaster & acid plant, replacement w/electric furnace	5,000,000	450,000	.03
	Part.	ESP, B.H. or scrubber	1,500,000	21,200	.19
Converter Aisle, Transfer Pts., etc.	SO_2	Hooding, scrubbing, elevated discharge	2,000,000	196,000	.03
	Part.	Hooding, scrubbing elevated discharge	1,000,000	2,430	1.13
Lime Kiln	Part.	Venturi scrubber	90,000	5,000	.05
Lime Crushing	Part.	Hooding, Baghouse	40,000	468	.23
Acid Plant	SO_2	Tail gas scrubbing	150,000	1,000	.41
	Part.	Tail gas scrubbing	-	-	-
Reverberatory Feed Storage	Part.	Enclose area	200,000	2,000	.23
Reverberatory Feed Dryer	Part.	High efficiency scrubber	150,000	270	1.51
Fire Refinery Furnace	Part.	Improved incineration or particulate collector	500,000	1,800	.76
Power Boilers	SO_2	Lower sulfur fuel	650,000	1,000	1.78
	Part.		-	-	-
Copper Ore Crusher	Part.	Additional hooding and baghouse	50,000	900	.15
Silica Rock Crusher	Part.	Water spray or enclose dump area	8,000	20	1.00

TABLE III-1 (CONT'D.)

DEMONSTRATED CONTROL TECHNOLOGY, EMISSION REDUCTION, AND COST

SOURCE	DEMONSTRATED CONTROL TECHNOLOGY	ANNUALIZED COST $/YR	AMOUNT REDUCED #/D	COST EFFECTIVENESS $/#
ESP Dust Loadout	Part. Enclose and add baghouse	10,000	475	.06
In-Plant Traffic	Part. Paving and sweeping	300,000	2,400	.34
Tailings Pile	Part. Vegetation, soil stabilization	700,000	1,000	1.92
Santa Rita Mine	Part. Additional watering	60,000	1,000	.16
Road to Limestone Quarry	Part. Paving	130,000	1,000	.36
Ore Train	Part. Soil stabilization	12,000	580	.06
Hurley	Part. Paving and sweeping	50,000	3,000	.05
Bayard	Part. Paving	100,000	3,700	.07
Mathis Lime Kiln and road	Part. High efficiency scrubber and paving road	140,000	4,000	.10
Fierro		20,000	110	.50
Hanover		20,000	110	.50
Vanadium		20,000	110	.50

Reverberatory Furnace - Particulate

The study by Pedco Environmental[4] for EPA on particulate removal, "Evaluation of Particulate Matter Control Equipment for Copper Smelters" indicates that a gas cooler and ESP or baghouse could be installed for a capital cost of $6,000,000 and annualized at $1,500,000. Control of particulate will require gas cooling, and unless concurrent SO_2 removal occurs, the reduction in plume rise may increase ground-level SO_2 concentrations. It is estimated that an emission reduction of 90% could be achieved.

Converter Aisle, Transfer Pts., etc. - SO_2 and Particulate

Additional control of the emissions from this area can be achieved by secondary hooding of convertors and by using or improving existing hoods over the matte tapping areas. Collected gas and particulate could be released at an elevated location, or passed through a caustic scrubber. Cost estimates taken from "Secondary Hooding for Pierce-Smith Converters", Pedco Environmental, December 1976, show annualized costs to be $500,000 for three converters. With additional hooding and an emission reduction of 65%, annualized costs of $1,000,000 are estimated.

Lime Kiln

Lime kilns are commonly controlled with venturi scrubbers. At an estimated 30,000 acfm and $6/acfm, capital costs are estimated at $180,000, and annualized cost at $90,000. An additional 95% emission reduction is estimated.

Lime Crushing

Crushing could be moderately controlled with a hooding and baghouse installation sized at 40,000 cfm. Baghouse installed cost of $6/cfm, capital cost is $240,000, annualized cost estimated at $40,000. An emission reduction of 90% could be expected.

Acid Plant

At 100,000 acfm, a low efficiency caustic scrubber applied to acid plant tail gas is estimated to cost $250,000, with an annual cost of $150,000. Expected SO_2 reduction is 40% SO_x minimal particulate reduction could be expected.

Reverberatory Feed Storage

It appears this source could best be controlled by constructing a building over the entire area. At $\$10^6$ capital cost for an enclosure, annualized costs are estimated at $200,000. An emission reduction of 95% is estimated.

Reverberatory Dryer

It is estimated that to achieve an additional substantial emission reduction would require replacement of the existing unit with a venturi scrubber at 60,000 acfm, annualized cost estimated at $150,000. Emission reduction is estimated at 60%.

Refinery Furnace

Although a portion of the emission from this furnace is organic and could be reduced by incineration, much of the emission is inorganic and would require a particulate control device. Ecology Audit measured volumes of 160,000 acfm from the stack. At a minimum the capital cost of a scrubber, ESP, or baghouse with precooler would cost $1,500,000, with annualized cost of $500,000. It is estimated a 90% emission reduction could therefore be achieved.

Power Boilers

Halfing the percent sulfur in fuel burned is estimated to increase cost by 8¢/gallon. At about 1,000 gal/hr consumption, annualized cost is $650,000/year.

For particulate, further control does not appear practical.

Copper Ore Crushing

Further hooding and a baghouse could reduce emissions from this source. Annualized costs for a baghouse are estimated at $50,000. An estimated 90% additional reduction could be expected.

Silica Rock Crushing

Additional hooding, enclosure and ventilation to a baghouse would cost an estimated $40,000 on an annualized basis. Additional emission reduction of 50%.

ESP Dust Loadout

This source could be controlled with an enclosure and baghouse for an annualized cost of $45,000. Emission reductions expected at 95%.

In-Plant Traffic

It is estimated that an expenditure of $300,000/year would keep the plant area paved and swept. The estimated emission reduction is 70%.

Tailings Pile

Some reduction probably could be achieved by planting vegetation or applying soil stabilization. Vegetation would require adding topsoil and possibly watering. One dust suppression vendor contacted said the cost was $1000/acre and would need re-application every five years. The Anaconda Company is experimenting with covering the pile with limestone culls, which appears to have some success. Any of these programs would cost a minimum of $2,000 an acre when some operational costs are included at present worth. At $2,000/acre, the cost is $3,600,000.

A paper by P.C. Dean, et al, "Vegetation Stabilization in Mill Mineral Wastes" verifies this cost information.

Annualized cost is estimated at $700,000. An estimated 50% reduction may be expected.

Santa Rita Mine

Additional watering by adding a truck, one man for one shift would require an annual expenditure of $60,000. Reduction is estimated at 30%.

Road to Limestone Quarry

Cost of paving at $\$1/ft^2$ totals approximately $400,000 for the three mile road. Maintenance and amortization result in $130,000 annualized cost. Estimated reduction is 95%.

Ore Train

Applying dust suppressant chemicals to a 40 foot right-of-way for seven miles, at $3¢/ft^2$ equals a capital cost of $44,000. Re-application every five years and labor places annual cost at $12,000/year. Reduction estimated at 80%.

Non-Kennecott Industrial Sources

Technology control costs and reduction are similar to Kennecott sources.

Municipalities

Annualized costs were based on capital for paving of streets at $\$1/ft^2$ and sweeping and maintenance.

SECTION IV

EXISTING AIR QUALITY, PROJECTED AIR QUALITY, AND COST EFFECTIVENESS OF CONTROL STRATEGY

During 1977 there were eight TSP monitoring sites near Hurley, operated by Kennecott Copper and/or the New Mexico EIA. Five of those eight are shown on the base map in Figure IV-1. The 1977 emission inventory as presented in Table II-1 was used together with a stability wind rose calculated for the Hurley area as input to the Air Quality Display Model (AQDM). It was found that the AQDM gave excellent correlation with observed TSP values except for the Bayard site. A field examination of the Bayard site revealed possible bias due to sampler location and fugitive dust from a gravel parking lot and roads. It is very doubtful that sources other than fugitive dust could account for the high concentrations reported at the Bayard site. To calibrate the AQDM, only the seven other sites were used in the correlation. It was found that the AQDM calculated TSP levels at the seven sites compared very well with the observed values. A linear correlation coefficient of 0.964 was calculated (1.0 is a perfect fit). Therefore, it appears that the AQDM is adequate to represent the general distribution of TSP for the area encompassed by the seven monitoring sites. Table IV-1 lists the observed and predicted TSP levels for the TSP monitoring sites in 1977.

Figure IV-2 shows the predicted 1977 annual geometric TSP concentrations near Hurley. The area shown to exceed the NAAQS of 75 $\mu g/m^3$ is about two km^2 with the higher concentrations being within Kennecott's fenced area. Table IV-2 lists the relative percent contribution of the major sources to the two highest monitoring sites (Hurley Shops and South Hurley) and to the highest AQDM receptor. As shown, the relative contribution changes with each receptor but general trends are noted:

a) The reverberatory furnace stack emission have little impact on the ground-level concentrations near Hurley.

b) Non-traditionally controlled sources such as fugitive dust and traffic related sources must be controlled to achieve the NAAQS.

To aid in the development of Reasonable Available Control Technology (RACT) a cost effectiveness listing is presented in Table IV-3. These calculations were derived by dividing the annualized cost of the demonstrated control technology by the expected reduction in ambient TSP concentration at the maximum receptor. The change in ambient concentrations is that resulting from demonstrated control technology. This table can be used to prioritize emission reductions that would allow the maximum reduction in ambient concentration while minimizing the cost of control. It can be easily seen that the cost effectiveness of controlling the reverberatory furnace ($12 x 10^6 per $\mu g/m^3$) is extremely less desirable than controlling sources such as the ESP dust loadout ($860 per $\mu g/m^3$).

The AQDM computer printout is listed in Appendices A and B for the 1977 emission rates.

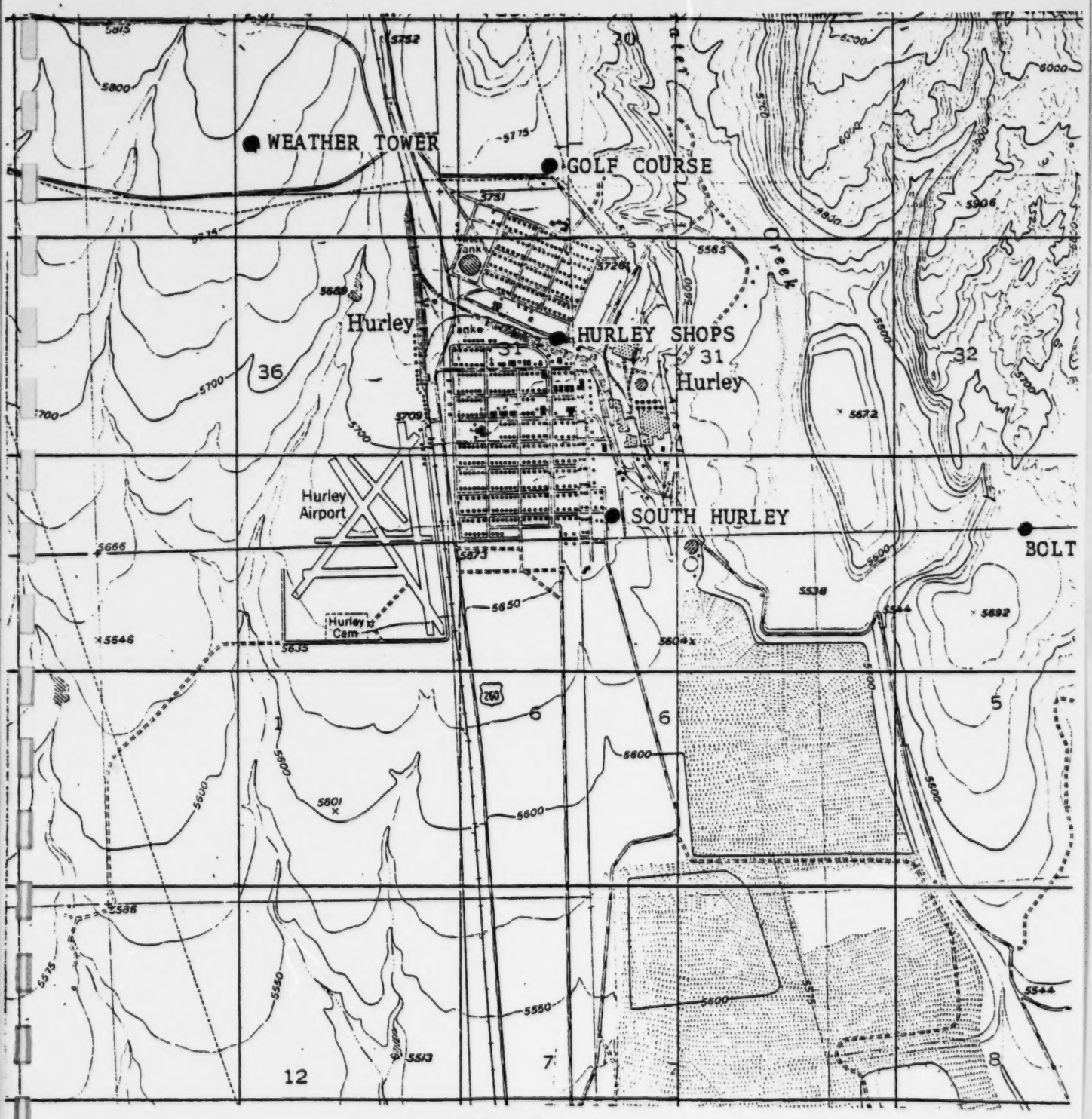


FIGURE IV-1

HURLEY AREA BASE MAP SHOWING

FIVE OF THE EIGHT TSP MONITORING SITES.

TABLE IV-1

POLLUTANT MONITORING DATA USED IN AQDM ANALYSIS

KENNECOTT MONITORING SITE	1977 ANNUAL AVERAGE ARITHMETIC TSP CONCENTRATION ($\mu g/m^3$)	
	Predicted	Observed
Bayard	Not Applicable	121 [a]
Golf Course	78	66
Hurley Shops	140	135 [b]
South Hurley	96	113
Bolton	51	45
Geronimo	40	32
Weather Tower	55	60
Airport	35	43

a) State data show: 1976 @ 143 $\mu g/m^3$
1977 @ 172 $\mu g/m^3$

b) State data show: 1976 @ 143 $\mu g/m^3$
1977 @ 148 $\mu g/m^3$

Note: Primary TSP NAAQS: 75 $\mu g/m^3$ (Geometric mean)
or approx.: 90 $\mu g/m^3$ (Arithmetic mean)

FIGURE IV-2 ESTIMATED 1977 ANNUAL GEOMETRIC MEAN TSP CONCENTRATIONS ($\mu g/m^3$)

Note: NAAQS = 75 $\mu g/m^3$

TABLE IV-2

RELATIVE PERCENT TSP CONTRIBUTIONS
OF THE MAJOR SOURCES TO THREE RECEPTORS

SOURCE NAME	PERCENT CONTRIBUTION (%)		
	Hurley Shops	South Hurley	Max Receptor[a]
Reverberatory Furnace	neg.	neg.	neg.
Lime Kiln	9	4	neg.
Lime Crushing	7	2	5
Copper Ore Crushing	5	4	2
ESP Dust Loadout	4	1	9
Reverberatory Feed Storage	12	5	46
Converter Aisle, Transfer Points	5	4	neg.
Kennecott Plant Traffic	5	17	9
Hurley Roads	26	25	10
Central Roads	1	2	1
Background (Natural)	23	33	15
Estimated Needed Reduction	37	8	59
Estimated Arith. Average ($\mu g/m^3$)	140	96	213

a) The maximum receptor is that receptor in a 250 m x 250 m receptor grid that shows the highest TSP concentration.

TABLE IV-3

COST EFFECTIVENESS

SOURCE	DEMONSTRATED CONTROL TECHNOLOGY	ANNUALIZED COST $/YR	AMOUNT REDUCED #/D	COST EFFECTIVENESS	
				SOURCE $/#	AIR QUALITY $/μg/m³
Reverberatory Furnace	SO_2 Gas blending & acid plant, roaster & acid plant, replacement w/other smelting technology	5,000,000	450,000	.03	-
	Part. ESP, B.H. or scrubber	1,500,000	21,200	.19	12,000,000
Converter Aisle, Transfer Points, etc.	SO_2 Hooding, scrubbing, elevated discharge	2,000,000	196,000	.03	-
	Part. Hooding, scrubbing, elevated discharge	1,000,000	2,430	1.13	290,000
Lime Kiln	Part. Venturi scrubber	90,000	5,000	.05	20,000
Lime Crushing	Part. Hooding, Baghouse	40,000	468	.23	14,000
Acid Plant	SO_2 Tail gas scrubbing	150,000	1,000	.41	-
	Part. Tail gas scrubbing	-	-	-	-
Reverberatory Feed Storage	Part. Enclose area	200,000	2,000	.27	1,900
Reverberatory Feed Dryer	Part. High efficiency scrubber	150,000	270	1.51	12,500,000
Fire Refinery Furnace	Part. Improved incineration and particulate collector	500,000	1,800	.76	4,000,000
Power Boilers	SO_2 Lower sulfur fuel	650,000	1,000	1.78	-
	Part.	-	-	-	-
Copper Ore Crusher	Part. Additional Hooding and baghouse	50,000	900	.15	15,000
Silica Rock Crusher	Part. Water spray or enclose dump area	8,000	20	1.00	12,000

TABLE IV-3 (CONT'D.)

COST EFFECTIVENESS

SOURCE	DEMONSTRATED CONTROL TECHNOLOGY	ANNUALIZED COST $/YR	AMOUNT REDUCED #/D	COST EFFECTIVENESS	
				SOURCE $/#	AIR QUALITY $/μg/m^3
ESP Dust Loadout	Part. Enclose and add baghouse	10,000	475	.06	860
In-Plant Traffic	Part. Paving and sweeping	300,000	2,400	.34	35,000
Tailings Pile	Part. Vegetation, soil stabilization	700,000	1,000	1.92	3,100,000
Santa Rita Mine	Part. Additional watering	60,000	1,000	.16	2,800,000
Road to Limestone Quarry	Part. Paving	130,000	1,000	.36	88,000
Ore Train	Part. Soil Stabilization	12,000	580	.06	12,000
Hurley	Part. Paving and sweeping	50,000	3,000	.05	1,300
Bayard	Part. Paving .	100,000	3,700	.07	180,000
Mathis Lime Kiln and road	Part. High efficiency scrubber and paving road	140,000	4,000	.10	820,000
Fierro		20,000	110	.50	8,000,000
Hanover		20,000	110	.50	5,700,000
Vanadium		20,000	110	.50	2,700,000

SECTION V

IMPACT OF PROPOSED REGULATIONS

The New Mexico EIA developed proposed allowable emission regulations based in part upon the cost effectiveness of potential control techniques and the needed reductions in ambient concentration discussed in previous sections. The proposed regulations will effect the emissions from Kennecott's reverberatory furnace, converter aisle and transfer points, lime kiln, lime crusher, acid plant, reverberatory feed storage, fire refinery furnace, ESP dust loadout, and in-plant traffic. Also affected will be streets and roads located in Hurley. The proposed regulations are included in Appendix D.

Table V-1 lists the affected sources and the maximum calculated emissions allowable under the proposed regulations. As shown, up to a 95 percent reduction is proposed for some sources.

The maximum calculated emissions allowable under the proposed regulations were used to predict the expected ground-level concentration of TSP if the proposed regulations are adopted. Figure V-1 shows the spacial distribution of the predicted TSP levels assuming that the regulations are adopted. As can be seen, no violations of the NAAQS of 75 $\mu g/m^3$ are expected with the proposed regulations. Indeed, when compared with the ambient levels of 1977 (Figure IV-2) significant improvement is noted.

Table V-2 lists a comparision of the 1977 air quality to that expected under the proposed regulations. It is expected that the air quality at the Hurley Shops and South Hurley monitors will improve by up to 45 percent. Up to a 65 percent improvement can be demonstrated at some locations. The reductions in emissions will result in TSP concentrations below the NAAQS of 75 g/m^3. It is expected that the Hurley Shops monitor will have a concentration of 66 g/m^3 which is 12 percent below the standard. This seems to be a reasonable margin of safety to ensure attainment of the NAAQS at that monitor.

Appendix E lists the AQDM computer printout for the allowable emissions.

TABLE V-1

SOURCES EFFECTED AND EXPECTED EMISSION REDUCTIONS
FROM IMPLEMENTATION OF PROPOSED REGULATIONS

SOURCE	PROPOSED REGULATION	CURRENT EMISSIONS	CALCULATED ALLOWABLE EMISSIONS	% EMISSION REDUCTIONS
Reverberatory Furnace	506.B.1 1100 #/hr	1529 #/hr for 1/2 year	1100 #/hr 13.2 T/D	28%
Converter Aisle, Transfer Pts, etc.	510 A,1,2,3 Hooding & stack	SO_x 153 T/D	107 T/D roof exit, 46 T/D stack	30% out roof
		Part. 1.89 T/D	1.3 T/D roof exit, .57 T/D stack	30% out roof
Lime Kiln	509 B 10 #/hr	220 #/hr	10 #/hr 12 T/D	95%
Lime Crusher	509 C Fabric Filter or equiv.	.26 T/D	.026 T/D	90%
Acid Plant	506 B,2 .05 gr/dscf	.04 gr/dscf	No change	0
Reverb. Feed Storage	510 C Enclosure	.93 T/D	.04 T/D	95%
Fire Refinery Furnace	506 A,B,C,D		1 T/D	0
	30#/hr charging	16.1#/hr		
	50#/hr blowing	25.8#/hr		
	200#/hr poling	98.1#/hr		
	550#/hr fluxing	not measured		
ESP Dust Loadout	510 B Enclosure & Fabric filters	.25 T/D	.013 T/D	95%
In-Plant Traffic	510 D Paving & Dust Suppressing	1.86 T/D	.93 T/D	50%
Hurley Streets & Roads	511 A Paving & Dust Suppressing	1.9 T/D	1.14 T/D	40%

TABLE V-2

ESTIMATED IMPROVEMENT IN AIR QUALITY

RECEPTOR	ANNUAL AIRTHMETIC TSP CONCENTRATION ($\mu g/m^3$)		IMPROVEMENT IN AIR QUALITY
	1977	Proposed Regs.	
Hurley Shops	140	77	45%
South Hurley	92	66	31%
Maximum Receptor (Table IV-2)	213	74	65%

Note: Primary NAAQS: 75 $\mu g/m^3$ (Geometric Mean)
or approx: 90 $\mu g/m^3$ (Arithmetic Mean)

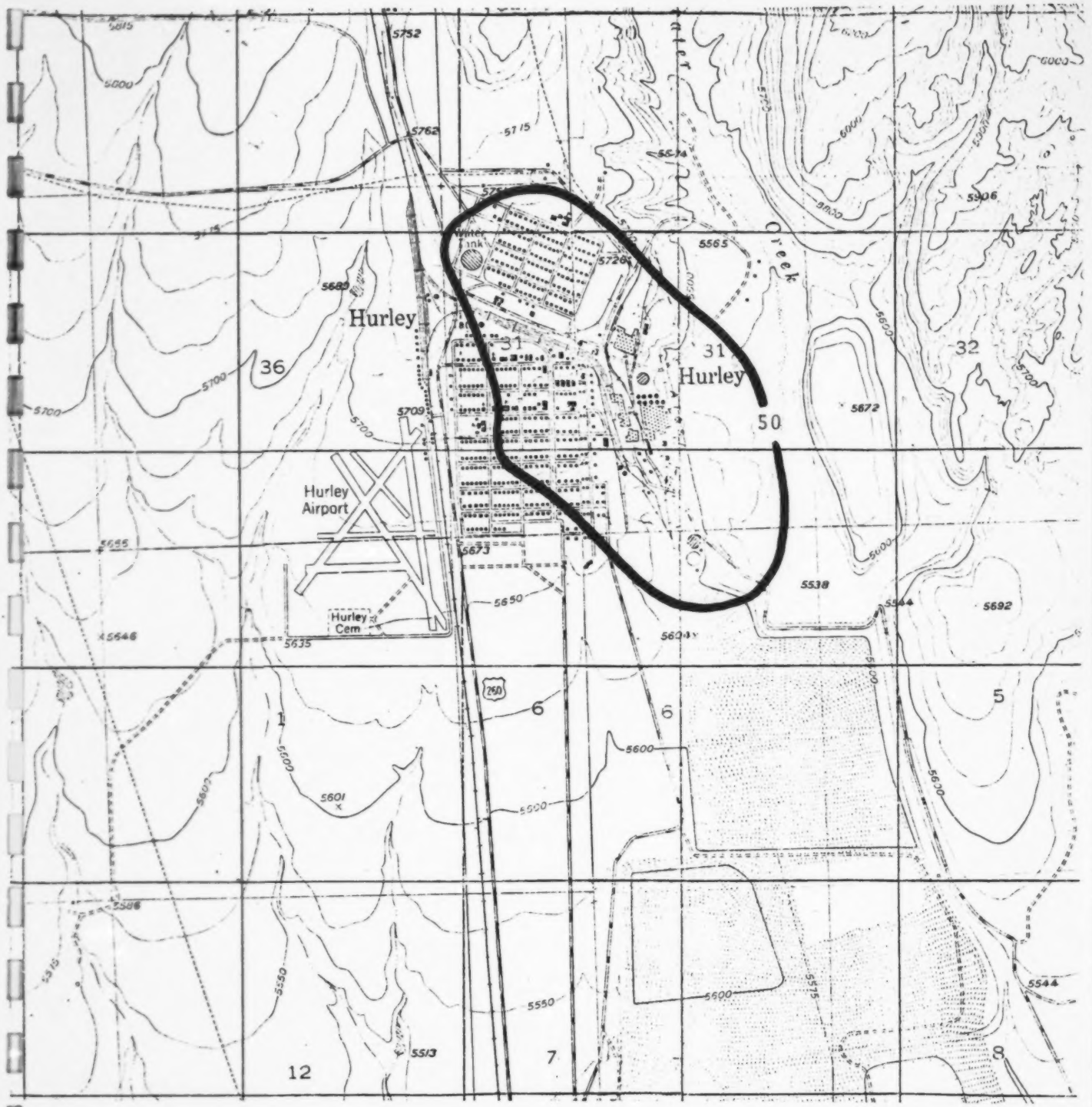


FIGURE V-1 PREDICTED ANNUAL GEOMETRIC MEAN TSP CONCENTRATION WITH PROPOSED REGULATIONS ($\mu g/m^3$)

Note: NAAQS = 75 $\mu g/m^3$

LIST OF REFERENCES

REFERENCE 1 "Source Emissions Survey, Kennecott Copper Corporation, Copper Smelter, Hurley, New Mexico", Ecology Audits, March 1978.

REFERENCE 2 Letter Dated August 8, 1978, from Mr. M. Madden, Kennecott Copper Corporation, Chino Mines Division, to Mr. D. R. Holtz, Engineering-Science.

REFERENCE 3 Letter Dated July 28, 1978, from Mr. D. R. Holtz, Engineering-Science, to Mr. Madden, Kennecott Copper.

REFERENCE 4 "Evaluation of Particulate Matter Control Equipment for Copper Smelters", PedCo Environmental, February 1978.

REFERENCE 5 "Particulate Matter Emissions from Selected Arizona Copper Smelters", Lawrence J. Bowerman.

REFERENCE 6 "Compilation and Analysis of Design and Operating Parameters of the Smelter at Kennecott Copper Corporation, Chino Mines Division, Hurley, New Mexico, for Emission Control Studies", Pacific Environmental Services, Inc., July 1975.

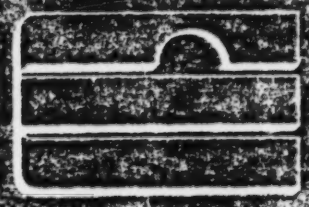
REFERENCE 7 Conversation with Maurice Madden of Kennecott, in which he stated the lime kiln test was conducted on June 9, 1978 and was available for review.

REFERENCE 8 "Allowable SO_2 and Particulate Emissions for Kennecott's Chino Mines Smelter", Intera Environmental Consultants, Inc.

REFERENCE 9 Conversation with Maurice Madden of Kennecott concerning source tests conducted by Ecology Audits for Kennecott in 1975.

REFERENCE 10 Testimony of Bruce Nicholson of the New Mexico Environmental Improvement Division.

REFERENCE 11 Conversation with David Maugham of the Montana Air Quality Bureau.



SOURCE EMISSIONS SURVEY
KENNECOTT COPPER CORPORATION
COPPER SMELTER
HURLEY, NEW MEXICO

MARCH 1978

ECOLOGY AUDITS, INC.
Subsidiary of Core Laboratories, Inc.
DALLAS, TEXAS · LAKE CHARLES, LOUISIANA · CASPER, WYOMING

APPENDIX A

ECOLOGY AUDITS 1978 SOURCE TEST

July 28, 1978 letter from ES to Kennecott

August 8, 1978 letter from Kennecott to ES

SUMMARY OF RESULTS

The principal conclusions are as follows:

Acid Plant Outlet

1. The emissions of particulate matter from the acid plant are equal to 0.0380 grains per dry standard cubic foot (22.2 pounds per hour), based on averaging the last three tests and using the collections from the "front-half" of the EPA-type sampling train plus the weight of sulfur trioxide in the first impinger.

2. The emissions of sulfur dioxide from the acid plant are equal to 149 parts per million (105.9 pounds per hour), based on averaging the four tests.

3. The emissions of sulfur trioxide from the acid plant are equal to 14 parts per million (9.5 pounds per hour), based on averaging the last three tests.

Reverberatory Furnace Stack

1. The emissions of particulate matter from the reverberatory furnace stack are equal to 0.4844 grains per dry standard cubic foot

(457.7 pounds per hour), based on averaging the three tests and using the collections from the "front-half" of the EPA-type sampling train plus the weight of sulfur trioxide in the first impinger.

2. The emissions of sulfur dioxide from the reverberatory furnace stack are equal to 21,560 parts per million (23,670.8 pounds per hour), based on averaging the three tests.

3. The emissions of sulfur trioxide from the reverberatory furnace stack are equal to 101 parts per million (110.1 pounds per hour), based on averaging the three tests.

Reverberatory Dryer Stack

The emissions of particulate matter from the reverberatory dryer stack are equal to 0.0864 grains per dry standard cubic foot (17.1 pounds per hour), based on averaging the three tests and using both the "front-half" and "back-half" collections from the EPA-type sampling train.

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Refinery Furnace Stack

The emissions of particulate matter from the refinery furnace stack are equal to 0.0818 grains per dry standard cubic foot (46.7 pounds per hour), based on averaging the three tests and using both the "front-half" and "back-half" collections from the EPA-type sampling train.

SUMMARY OF RESULTS

Acid Plant Outlet

Run Number	1		
Stack Flow Rate - ACFM	97,913		
Stack Flow Rate - Dry DSCFM*	66,239		
% Water Vapor - % Vol.	0.3		
% CO_2 - % Vol.	0.3		
% O_2 - % Vol.	11.7		
% Excess Air @ Sampling Point	--		
Particulates Probe, Cyclone, Filter Catch & Impinger #1 SO_3 grains/dscf*	0.0451		
grains/cf @ Stack Conditions	0.0304		
lbs/hr	25.6		
Probe, Cyclone & Filter Catch grains/dscf*	0.0442		
grains/cf @ Stack Conditions	0.0298		
lbs/hr	25.1		
Probe, Cyclone & Filter Catch minus SO_3 grains/dscf*	0.0291		
grains/cf @ Stack Conditions	0.0196		
lbs/hr	16.5		

* 29.92 "Hg, 68°F

SUMMARY OF RESULTS

Acid Plant Outlet

Run Number	2	3	4
Stack Flow Rate - ACFM	93,301	118,538	102,153
Stack Flow Rate - DSCFM*	62,761	80,383	69,339
% Water Vapor - % Vol.	1.6	0.1	0.4
% CO_2 - % Vol.	0.3	0.1	0.2
% O_2 - % Vol.	14.9	11.2	17.1
% Excess Air @ Sampling Point	--	--	--
Particulates			
Probe, Cyclone, Filter Catch & Impinger #1 SO_3			
grains/dscf*	0.0582	0.0232	0.0325
grains/cf @ Stack Conditions	0.0390	0.0157	0.0220
lbs/hr	31.3	16.0	19.3
Probe, Cyclone & Filter Catch			
grains/dscf*	0.0284	0.0186	0.0317
grains/cf @ Stack Conditions	0.0190	0.0149	0.0214
lbs/hr	15.3	12.8	18.8
Probe, Cyclone & Filter Catch minus SO_3 grains/dscf*	0.0189	0.0088	0.0189
grains/cf @ Stack Conditions	0.0127	0.0059	0.0128
lbs/hr	10.2	6.0	11.3

* 29.92 "Hg, 68°F
20°C

SUMMARY OF RESULTS

Acid Plant Outlet

Run Number	Sulfur Dioxide ppm	Sulfur Dioxide lbs/hr	Sulfur Trioxide ppm	Sulfur Trioxide lbs/hr
1	240	158.7	11*	7.0*
2	41	25.4	26	16.2
3	194	155.7	9	6.9
4	121	83.7	8	5.3
Average	149	105.9	14	9.5

* Not used in averages.

SUMMARY OF RESULTS

Reverberatory Furnace Stack

Run Number	1	2	3
Stack Flow Rate - ACFM	242,024	229,640	234,226
Stack Flow Rate - DSCFM*	112,376	108,115	109,405
% Water Vapor - % Vol.	8.9	7.6	8.6
% CO_2 - % Vol.	3.1	4.0	2.8
% O_2 - % Vol.	12.6	13.2	12.8
% Excess Air @ Sampling Point	138	159	144
Particulates			
Probe, Cyclone, Filter Catch & Impinger #1 SO_3			
grains/dscf*	0.5811	0.3558	0.5162
grains/cf @ Stack Conditions	0.2503	0.1593	0.2271
lbs/hr	559.6	329.6	484.0
Probe, Cyclone & Filter Catch			
grains/dscf*	0.5698	0.3086	0.4430
grains/cf @ Stack Conditions	0.2455	0.1382	0.1948
lbs/hr	548.8	286.0	415.4
Probe, Cyclone & Filter Catch minus SO_3 grains/dscf*	0.4169	0.1893	0.3043
grains/cf @ Stack Conditions	0.1796	0.0861	0.1339
lbs/hr	401.5	175.4	285.3

* 29.92 "Hg, 68°F

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SUMMARY OF RESULTS

Reverberatory Furnace Stack

Run Number	Sulfur Dioxide ppm	Sulfur Dioxide lbs/hr	Sulfur Trioxide ppm	Sulfur Trioxide lbs/hr
(1)	23,165	25,945.5	86	96.5
2	15,589	16,797.9	94	101.0
3	25,925	28,269.1	122	132.7
Average	21,560	23,670.8	101	110.1

SUMMARY OF RESULTS

Reverberatory Dryer Stack

Run Number	1	2	3
Stack Flow Rate - ACFM	41,838	40,541	40,890
Stack Flow Rate - DSCFM*	23,764	23,313	22,459
% Water Vapor - % Vol.	20.9	20.0	23.1
% CO_2 - % Vol.	3.2	3.0	3.0
% O_2 - % Vol.	15.8	16.4	16.0
% Excess Air @ Sampling Point	279	331	293
Particulates			
Probe, Cyclone & Filter Catch grains/dscf*	0.0699	0.0903	0.0882
grains/cf @ Stack Conditions	0.0396	0.0517	0.0483
lbs/hr	14.2	18.0	17.0
Total Catch			
grains/dscf*	0.0753	0.0936	0.0902
grains/cf @ Stack Conditions	0.0426	0.0537	0.0494
lbs/hr	15.3	18.7	17.4

* 29.92 "Hg, 68°F

SUMMARY OF RESULTS

Refinery Furnace Stack

Run Number	1	2	3
Stack Flow Rate - ACFM	90,667	78,158	162,539
Stack Flow Rate - DSCFM*	57,807	53,614	72,912
% Water Vapor - % Vol.	1.3	0.7	1.4
% CO_2 - % Vol.	1.0	0.8	2.4
% O_2 - % Vol.	19.2	20.2	18.4
% Excess Air @ Sampling Point	986	2,748	711
Particulates			
Probe, Cyclone & Filter Catch grains/dscf*	0.0309	0.0552	0.1557
grains/cf @ Stack Conditions	0.0196	0.0378	0.0696
lbs/hr	15.3	25.4	97.3
Total Catch			
grains/dscf*	0.0324	0.0561	0.1570
grains/cf @ Stack Conditions	0.0206	0.0383	0.0702
lbs/hr	16.1	25.8	98.1

* 29.92 "Hg, 68°F

ES

ENGINEERING-SCIENCE, INC.

150 NORTH SANTA ANITA AVENUE · ARCADIA, CALIFORNIA 91006 · 213/445-7560

CABLE ADDRESS: ENGINSCI
TELEX: 67-5428

28 July 1978

Mr. Madden
Kennecott Copper
Hurley, New Mexico 88043

Dear Mr. Madden:

As you are aware, Engineering-Science has been contracted by EPA, Region VI to update the emission inventory for Grant County, including the Kennecott facility. Some of the information for this update was acquired during my visit to your plant last month, but as you suggested, the remaining information should be requested by letter. This letter is that request. It would be appreciated if you could answer the following questions, and get the answers to me by August 11, 1978.

Please answer for the calendar year 1977:

1. Average vehicle miles per day and average speed of trucks in Santa Rita mine; 2000 mi/day @ 15 mph
2. Amount of ore shipped to Hurley smelter; 6,806,000 tons mine to reduction plant
3. Amount of concentrate feed to reverberating dryer and reverberatory; 221,000 tons to dryer & reverbatory
4. Average amount of sulfur in feed; 250 T/D
5. Average sulfur balance for smelter;
6. Capacity of limestone crushing system and average hours of operation;
7. Average number of trips limestone haul trucks make in a day;
8. Capacity and number of hours of lime kiln operation. Also stack height, diameter and temperature;
9. Capacity and number of hours of silica flux crushing operation;
10. Average number of daily trips made by silica flux haul trucks;
11. Estimated daily vehicle miles traveled within the smelter complex, including trips to the tailing pile; 2 TRAIN CARS - TRIPS
12. Average number of ore train trips to smelter;

6 TRIPS / 04 AV.

13. Maximum plant design capacity in tons concentrate per year;

14. Tons concentrated ore processed in 1977.

Thank you very much for your interest and participation in this program.

Very truly yours,

Donald R. Holtz/as

Donald R. Holtz
Project Manager

DRH:as

Kennecott Copper Corporation

Chino Mines Division
Hurley, New Mexico 88043 (505) 537-3381

August 8, 1978

Mr. D. R. Holtz
Engineering-Science, Inc.
150 North Santa Anita Avenue
Arcadia, California 91006

Dear Mr. Holtz:

Attached is the information you requested in your July 28, 1978 letter. Section 114 of the Clean Air Act provides that, except for emission data, access to records, reports or information provided to EPA and designated as confidential by the business shall not be made available to the public.

Engineering-Science, Inc. is contracted by EPA Region VI to gather and evaluate the information you requested in your July 28 letter. All of the information provided is proprietary; therefore, it shall not be made available to the public or used for any other purpose than updating the emission inventory for Grant County, the stated purpose in your letter.

If you have any questions, please give me a call.

Yours very truly,

M. Madden
Environmental Control Director

MM/abc
Att.

"An Equal Opportunity Employer"